# CARTOGRAPHY OF IRREGULARLY SHAPED SATELLITES

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Irregularly shaped satellites, such as Phobos and Amalthea, do not lend themselves to mapping by conventional methods because mathematical projections of their surfaces fail to convey an accurate visual impression of landforms and because large and irregular scale changes make their features difficult to measure on maps. A digital mapping technique has therefore been developed by which maps are compiled from digital topographic and spacecraft image files. The digital file is geometrically transformed as desired for human viewing, either on video screens or on hard copy. Digital files of this kind consist of digital images superimposed on another digital file representing the three-dimensional form of a body.

The three-dimensional digital topographic files can be compiled by two methods: stereoscopic photogrammetry and control-point triangulation in conjunction with sculptured models. Stereoscopic photogrammetry provides the strongest analytical tool for deriving the three-dimensional form. We have compiled a digital image/topography mosaic of Miranda, based on topographic compilations [1] and on Voyager 2 images [2]. This file has been used to make 180 topographically corrected global views that have been incorporated into a movie. Selected members of this set will be produced as slides for general distribution, and several others will be used in a published image map of Miranda.

Existing stereoscopic-image coverage is inadequate for most of the irregular bodies because illumination variations make stereoscopic viewing difficult or impossible. There is sufficient stereoscopic convergence, however, to triangulate latitudes, longitudes, and radii for a collection of control points. Measurements can also be made indirectly, from a sculptured model. The sculpturing is performed through successive comparisons of illuminated models and similarly illuminated spacecraft images. A plaster model has been made with Mariner 9 images [3], but techniques are now available for doing the work digitally.

We have compiled a contour map of radii of Phobos on a spherical (simple cylindrical) array of latitudes and longitudes, based on the data of [3,4,5]. A "digital radius model" was then made by interpolation from the contour map. This model was converted from the spherical system (latitude, longitude, and radius) to the perspective view of a spacecraft image (X, Y, and Z), and the model was digitally shaded to simulate the spacecraft image [6]. Comparison of the resulting synthetic spacecraft image with the actual spacecraft image provides a basis for further sculpturing of the digital radius model.

We expect to produce an accurate geometric model of Phobos by iteration of this process, and we will then compile a three-dimensional mosaic of spacecraft images by the technique used for Miranda mapping. Similar mosaics are planned for Deimos, Amalthea, Hyperion, Epimetheus, and Janus.

References

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